EGR 322 Microcontroller System Design

Lab 5 – Pulse Width Modulation (PWM)

Prepared for: Dr. Foist

Christopher Parisi

College of Engineering
California Baptist University

03/06/12

Summary

This lab teaches students about the Pulse Width Modulation and how it is used to control analog devises with digital techniques. Students will learn about the PWM user module and practice using it with the global output resources.

Design

I began the project by starting anew project configuring the settings to the specified values given in the lab manual. I also configured the PWM8 user module to the given parameters.

Exercise 1

I copied the given main.asm file into my project and built and downloaded it to the Evall Board for testing. I used the oscilloscope to measure the related parameters and compared them to my hand calculations. The data I obtained, my hand calculations, and my oscilloscope screen shots are shown below.

Hand Calculations:

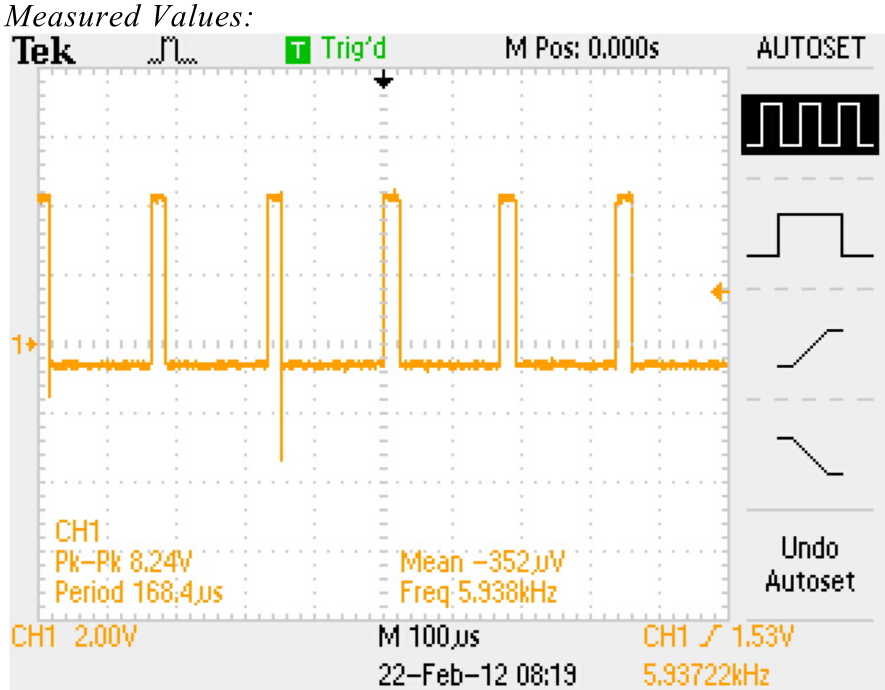
F_{clock} = 24MHz/16 = 1500000

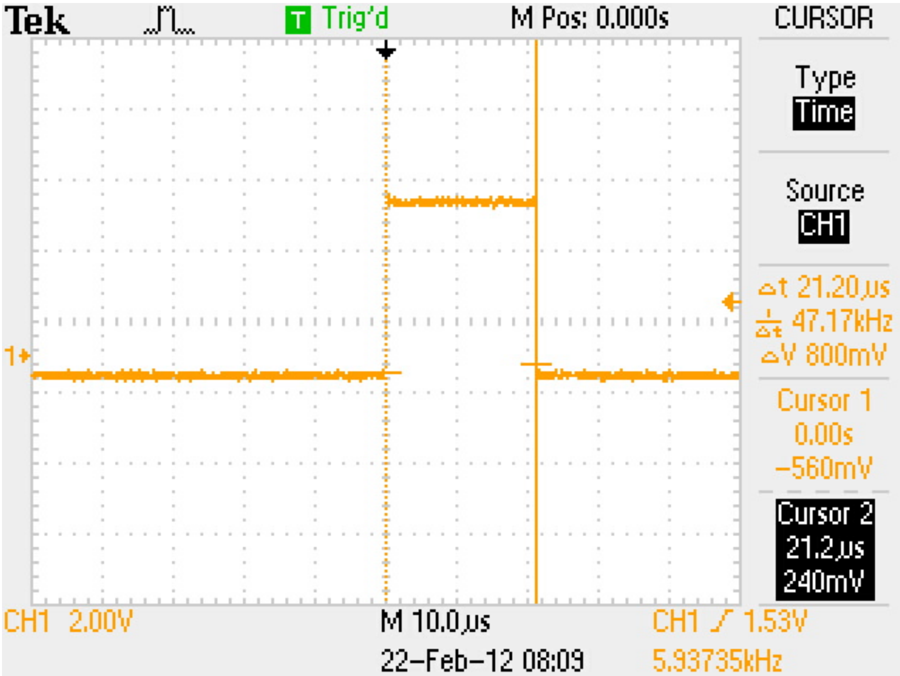
T_{out} = (Period+1)/F_{clock} = 256/1500000 = **170.66us**

32/255 = 0.125

0.125(170.66us) = **21.4us**

Measured Values:





Test Case	Calculated Period for the Pulse Signal from P14	Calculated Time Duration for High in Each Period for the Pulse Signal from P14	Calculated Duty Cycle	Measured Period for the Pulse Signal from P14	Measured Time Duration for High in Each Period for the Pulse Signal from P14	Measured Duty Cycle
Case 1: Period: 255 PulseWidth: 32	170.66us	21.4us	12.5%	168us	21.2us	12.5%

<u>Exercise 2</u>

I then copied the next main.asm file into my project and built and downloaded it to the Evall Board. This program made the LED brighter than the previous program. The hand calculations, measured values, and oscilloscope screen shots are shown below.

Hand Calculations:

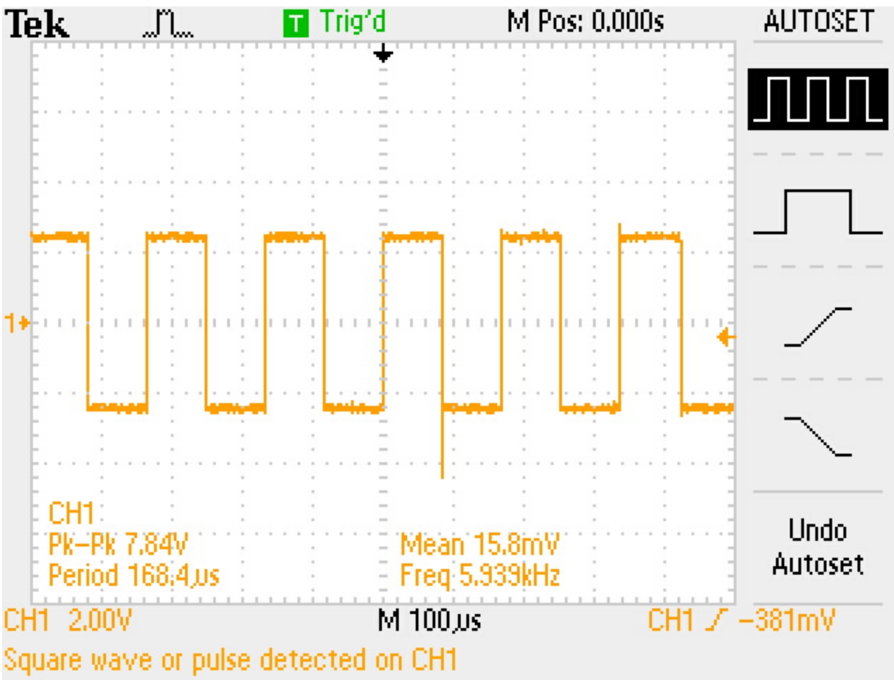
F_{clock} = 24MHz/16 = 1500000

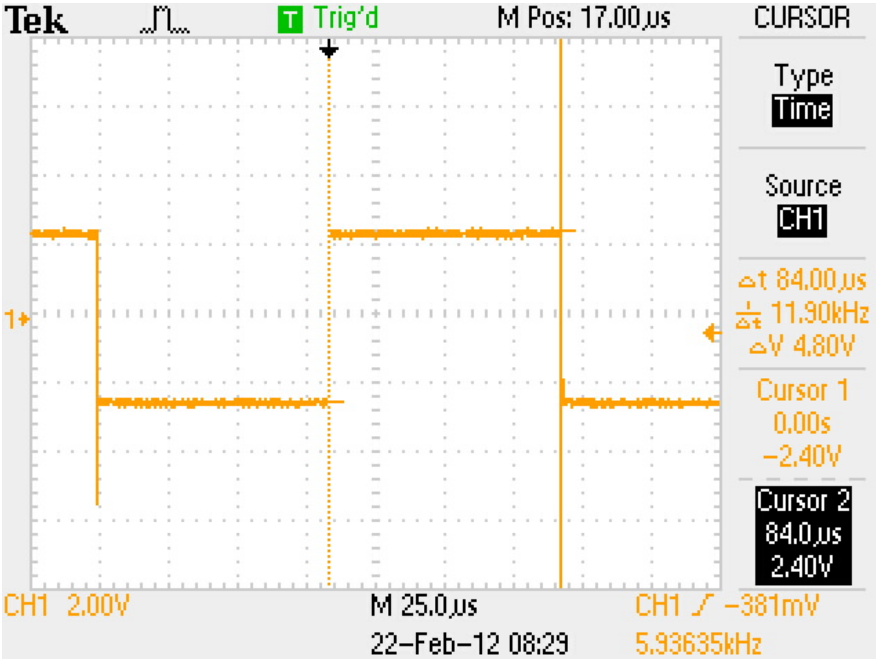
T_{out} = (Period+1)/F_{clock} = 256/1500000 = **<u>170.66us</u>**

128/255 = 0.501

0.501(170.66us) = **<u>85.6us</u>**

Measured Values:





Test Case	Calculated Period for the Pulse Signal from P14	Calculated Time Duration for High in Each Period for the Pulse Signal from P14	Calculated Duty Cycle	Measured Period for the Pulse Signal from P14	Measured Time Duration for High in Each Period for the Pulse Signal from P14	Measured Duty Cycle
Case 1: Period: 255 PulseWidth: 128	170.66us	85.6us	50.2%	168us	84us	50%

<u>Exercise 3</u>

I then combined the PWM with the sleep timer interrupt I wrote in Lab 4. This program adjusts the pulse width once every second starting from 0 up to 240 incrementing by 16. This increases the brightness of the LED every second. After completing the code, I tested it on the Evall board and the LED changed brightness every second as expected. My codes can be seen below.

main.asm

```
;-----------------------------------------------------------------------------
; Assembly main line
;-----------------------------------------------------------------------------
include "m8c.inc"       ; part specific constants and macros
include "memory.inc"    ; Constants & macros for SMM/LMM and Compiler
include "PSoCAPI.inc"   ; PSoC API definitions for all User Modules
include "PWM8.inc"

export _main

_main:
        mov reg[PRT1DR], 0x00
        mov reg[INT_MSK0], %01000000
        M8C_EnableGInt
loop: jmp loop
```

SleepTimerRoutine.asm

```
;-------------------------------
; SleepTimer ISR
;-------------------------------
include "m8c.inc"

export SleepTimerISR

area bss(RAM)
    temp: BLK 1

area text(ROM, REL)
    mov [temp], 0

SleepTimerISR:
    push A
    mov A, [temp]
    ADD A, 16
    mov [temp], A

    call PWM8_WritePulseWidth
```

```
call PWM8_Start


pop A
reti
```

Discussion

I did not encounter and problems with this lab besides coding errors that were easily fixed.

Conclusion

This lab has taught me about the Pulse Width Modulation technique. I have learned how to implement this technique using the assembly language and the PSoC designer. I also have learned how to implement the previous sleep timer interrupt into another application. This lab has been useful in accumulating my knowledge into one project.